Composting in Macedonia- Sound alternative or just a rotten idea?

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List of Abreviations:

Anaerobic Digestion - AD
European Commission - EC
European Union - EU
Good Farming Practice - GFP
Greenhouse Gases - GHG
Integrated Pollution Prevention and Control - IPPC
Mechanical Biological Treatment - MBT
Member States - MS
Ministry of Agriculture, Forestry and Water Economy - MoAFWE
Ministry of Environment and Physical Planning - MoEPP
Municipal Solid Waste - MSW
National Waste Management Plan - NWMP
National Waste Management Strategy - NWMS
Quality Assurance System - QAS
Republic of Macedonia - RM
Stabilisation and Association Agreement - SAA

Introduction

> "*…The world should start applying the concept of sustainable development into practice, in the form of everyday behavior, living in harmony with nature. This life is neither a fictive philosophy, nor high political agenda for the future. This living must happen now and here, for everybody and for everyone. To enable the above before everything else, it takes knowledge; it takes awareness for the moment of development of the civilization…*[1]"

In the European Union (EU) with 497 million inhabitants, biowaste accounts for 30-45% of the municipal solid waste (MSW). While in Macedonia, a country with only two million inhabitants has biowaste percentages near the percentage of the EU - 26.2%. In Macedonia biowaste includes waste materials with organic (animal and vegetal) origin, like household waste,[2] then restaurants, canteens food waste and green markets waste, as well as in the rural municipalities, agricultural wastes, wastes from livestock activities, gardening wastes and forest residues. Due to the high water content, high density (except for green waste which has low density) and the high putrescibility of this waste stream, it is crucial to be involved in integrated, sustainable waste management.

The MSW and its biowaste stream produced in Macedonia is landfilled (at official landfills) and dumped at thousands of illegal dumpsites. Furthermore, there is no separate collection of biowastes, only separate collection of paper as biowaste is realized by the communal enterprises. Additionally, the rural communities with main agricultural activities do not have official waste collection systems. The treatment of the agriculture wastes depend solely on the treatment practices of the farms. Because the agriculture sector in Macedonia lacks the Good Farming Practice (GFP), non compliance to basic technical and environmental requirements is often the case with the macedonian farms. This leads to pollution of soils, water courses and emissions of greenhouse gases (GHG) on the long run.

Positive results in biowaste minimizing can be attained through old or modern techniques like composting, anaerobic digestion (AD) of food, green wastes, recycling of paper, textiles, mechanical biological treatment (MBT) and incineration accompanied by strong public campaigns directed at raising awareness on waste reduction and waste-selection activities on municipality and household levels.

Composting has always been the pro-sustainable waste management strategy of our ancestors. Going back to making compost will ensure soil protection and climate change abatement,[3] for Macedonia has levels of greenhouse gases from the waste sector for the year 2004[4] between 10 kt and 99,9 kt methane in CO_2-eq emissions[5] and has low organic soil matter. Clearly it is crucial for the biowaste management to receive prominent policy attention.

In spite of having waste prevention and reduction, as a must for EU accession, it is also in the interest of the state and the entire population to undertake measures that would

1. Ministry of Environment and Physical Planning, *Annual Report on Data for the Quality of the Environment for the Year 2006* (Skopje, RM, 2007), 3.
2. The household waste consists mainly of food, as well as paper, garden waste, textiles.
3. This can be achieved through reduced use of artificial fertilizers and pesticides, as well as by reduced extraction and application of peat and carbon sequestration in soil and reduction (indirectly) in GHG emissions.
4. "Taking into account the 572 thousand tonnes of waste that had been generated in 2004 of which 97% has been landfilled or dumped." (European Commission-DG Environment, "Benefits for the former Yugoslav Republic of Macedonia and the other countries of SEE of compliance with the environmental acquis," *Europa – Environment*, http://ec.europa.eu/environment/enlarg/pdf/report_macedonia_feb08.pdf), 77.
5. *Ibid.*

lead to improvements regarding waste management. Growing waste volumes,[6] driven by changing production and consumption patterns, should drive policy actions towards shift in waste management choices, by making approaches, strategies in a less environmentally harmful direction according to the waste hierarchy.

This report gives background information on biowaste management, and in particular on composting as added value to traditional waste management with an overview of the current Macedonian policy framework on composting practices. It further discusses the extent to which Macedonian legislation is aligned with the EU standards. The report offers possible solutions to current and future challenges regarding the biowaste issue, thus increasing its importance enough to have it well covered by legislation and the relevant programs for environmentally sustainable development of the country.

Biowaste – a challenging issue

Biowaste (biodegradable waste) is defined on EU level in the Landfill Directive (1999/31/EC) as "any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and green waste, and paper and paperboard.[7]" In the EU, specific regulations determine the fate of these materials. They can be utilized for soil management purposes, disposed or subjected to alternative treatment (composting), leading to "ecologically compatible reutilization in agriculture, landscaping or reclamation of disturbed areas.[8]" In addition to the application or disposal "these materials may also be used for energy production.[9]"

The organic leftovers from households, agriculture, forestry activities have an ending life, bringing environmental hazards in the picture, because when disposed of at landfills they contribute to the global warming by producing a landfill gas which contains methane, known to be more potent greenhouse gas than CO_2 and N_2O.

Another constraint is pollution of the ground water due to the landfill leaching. Unlike the sanitary landfills, in the uncontrolled landfills there is no containment process of the leaching. It seeps away slowly and it's dispersed trough the ground.

Uncontrolled decomposition of the organic fraction of the disposed waste at landfills leads to a distortion in the present ecological community, humane habitat and on the global environment through the greenhouse effect. This means that besides pollution of surface water, groundwater, soil and air pollution, there are pathogenic microorganisms, insects, vermin, that start residing in a smelly and noisy area like the landfill, increasing the risk to human health.

Fortunately, alternative solutions to waste disposal at landfill like composting, AD, incineration are making their way into the market. The stringent regulations from EU that

6. 828 thousand t/year till 2025. UNDP, "National Strategy for Clean Development Mechanism," http://www.undp.org.mk/default.asp?where=publications, 10.
7. Official Journal of the European Communities (OJ) L 182/4. Landfill Directive. 16.7.1999, Art.2.
8. Reinhard F. Huttl and Mario Fussy, "Organic Matter Management-A Contribution to Sustainability" (paper presented at the scientific seminar on Applying Compost-Benefits and Needs, Brussels, Belgium, November 22-23, 2001).
9. *Ibid.*12; The list of biowastes suitable for biological treatment and/or spreading on the soil are shown in Annex I to the report.

were enacted for diverting organic or biodegradable wastes from landfills are therefore not surprising.

When referring to the situation with the biowaste in Macedonia there are data gaps on waste quality analysis, hence only estimations on waste quantities are possible.[10] The biowaste issue in Macedonia is a twofold one. On the one side is the biodegradable waste stream of the municipal solid waste. On the other side is biowaste in the agriculture sector. Municipal solid waste is one of the main generated waste streams in Macedonia consisting of household wastes, street sweepings and park green wastes, commercial-institutional waste and wastes generated in industry with a household-like character.[11] The biodegradable waste stream of MSW in Macedonia represents only 26.2%,[12] which is close to the data across EU, accounting for average 32% of the MSW.[13]

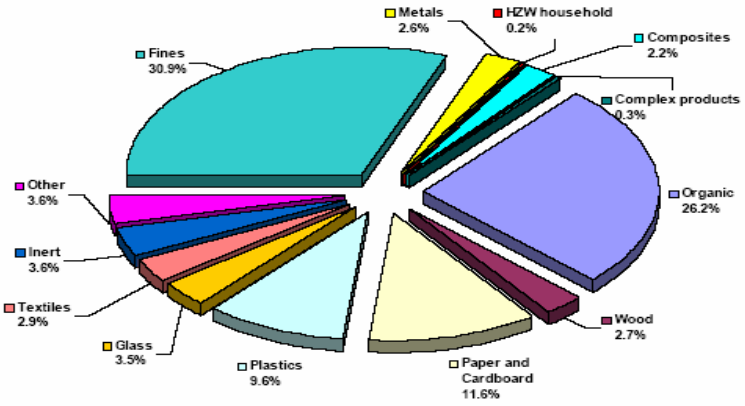

Figure 1: Composition of the total municipal (household and commercial) waste.

Source: *National Waste Management Plan 2006-2012*

Other major contributor to the biodegradable waste amounts is the agriculture sector. Agriculture has traditionally been amongst the three most important sectors in the economy of Macedonia. The total output of the agriculture industry of the agriculture for the year 2004 was 988.8 Mio. EUR, of which the agricultural goods output (including wine) accounted for 970.8 Mio. EUR.[14] The main contributors to the gross agricultural output (excluding wine) were the crop production, vegetable production, livestock products (meat, eggs, milk), fruit production, grape growing intended mainly for wine production and industrial plants production. Hence, the intensive and **still** outdated traditional agricultural practices lead towards environmental implications like soil pollution, water pollution, loss of biodiversity, habitats and landscapes[15] as well as towards substantial amount of agriculture and feedstock waste. Approximately 5,2 to 6,8 Mio.t/year, of which app. 4,2 to 6,8

10. "The available data and information on the sources, nature, quantities and fate of wastes and waste management facilities, are not sufficient to meet current or future EU and national requirements." (Ministry of Environment and Physical Planning, *National Waste Management Plan 2006-2012* (Skopje, RM, September, 2005), 68.
11. Approximately 0.57 Mio.t/year with prognosis of rising 1,7%/year up-to 0.70 Mio.t/y till the year 2020 or 285 - 350 kg/cap. year
12. Ministry of Environment and Physical Planning, *National Waste Management Plan 2006-2012* (Skopje, RM, September, 2005), 17.
13. Florian Amlinger, "Biowaste Management in the EU 25: Summarising the Results form the Questionnaire" (paper presented at the workshop Ecologically Sound Use of Biowaste in the EU, Brussels, Belgium, May 31- June 1, 2006).
14. ARCOTRASS-Consortium, "Study on the State of Agriculture in the Five Applicant Countries, The former Yugoslav Republic of Macedonia," http://ec.europa.eu/agriculture/analysis/external/applicant/macedonia_en.pdf ,12-13.
15. ARCOTRASS-Consortium, "Study on the State of Agriculture in the Five Applicant Countries, The former Yugoslav Republic of Macedonia," http://ec.europa.eu/agriculture/analysis/external/applicant/macedonia_en.pdf, 12-13.

Mio.t/year are waste from animal tissues[16] and approximately 0.496 Mio.t to 0.523 Mio.t/year of plant tissue waste[17] to represent the second biggest waste fraction, mainly addressed as by-products, i.e. these types of waste represent recyclable fractions in agricultural activities.[11]

	Crop production	Horticulture and vine- growing	Forestry	Extensive livestock	Intensive livestock
Waste from sheep husbandry				**	
Waste fertilizers	**	**	*		**
Crop residues	***	*	**		
Organic waste from vine and fruit trimmings		**			
Animal feedstock residues				*	**
Faeces/manure					***
Dead animals				*	**
Waste from primary processes	*	***			**
Interpretation: * insignificant amount of waste and/or insignificant potential influence **middle amount of waste and/or middle potential influence *** significant amount of waste and/or significant potential influence					

Table 1. Agriculture waste in Macedonia.

Source: *National Strategy on Clean Development Mechanism, for the first period of obligations according to the Kyoto Protocol, 2008-2012*

Composting - an alternative to landfilling biowaste

EU waste policy i.e. the action taken under the Thematic Strategy on Waste Prevention and Recycling contributes to continuing move of the waste flows away from landfill as in Article 5 of the Landfill Directive.[18] Macedonia, as an EU candidate country, has committed itself to fulfill the obligations of the Stabilization and Association Agreement (SAA) it signed with the EU. SAA's Article 103 is increasingly indicative of the urgency and importance of this issue.[19]

16. The animal tissues include animal carcasses from the food processing industry; eliminated animals of the programme for eradication of diseases and livestock diverted from production.
17. Plant tissue waste includes biomass from crops; vineyards; orchards and fresh plants in greenhouses and under plastic covers.
18. Referring to the Thematic Strategy on Waste Prevention and Recycling. European Commission, "Thematic Strategy on Waste Prevention and Recycling," *Europa-Environment*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0666:FIN:EN:PDF, 8.
19. SEI, "Stabilisation and Association Agreement," *Secretariat for European Affairs*, http://www.sei.gov.mk/portal/documents/support/sofijag-rad50576-2.PDF, Art. 103.

Landfilling, the oldest disposal method mankind is familiar with, in Macedonia accounted for 97%, while composting with 0% of the total waste management practices in the year 2004.[20] Comparing with the EU in 2004, 47% of the total municipal waste was landfilled and material recovery was used for 36% of the municipal waste. According to the European Environment Agency, in the study "From Landfilling to Recycling: Common Destination, Different Routes" there seem to be two strategies for diverting municipal waste from landfill: to aim for high material recovery combined with incineration, or to aim for material recovery which includes recycling, composting and MBT.

For Macedonia, the solution for the high rate of landfilling, along with the shortage of storage capacity for MSW and used up time-span of landfills, can be sought in steering the management of biowaste towards composting. This technology seems to be far more economically feasible than incineration, the less favorable option in the waste management hierarchy: "Both the financial costs, and the constraints on access to capital, should favor a strategy based on materials recovery rather than incineration (energy recovery or potential for energy recovery)[21]"

Environmental impacts are expected to decrease as composting is perceived as cleaner and environmentally more sustainable technology than incineration and landfilling.[22] Hence, composting has only minor negative effects on the environment, for example, for immature compost, adverse environmental effects relate to odor and air quality, as well as microbial presence, noise and dust from machine operations.[23] Since compost can rejuvenate poor (in organic matter) soils, it can resolve another major concern in Macedonia - the aggravated situation of low-soil organic content of just 2% in semi-arid regions[24] mainly resulting from obsolete agricultural techniques[25].

Composting is a controlled[26] process where collected and preferably source segregated organic waste,[27] i.e. raw products are microbiologically decomposed in aerobical circumstances resulting in a final product - **compost**, with high organic content. Feedstock for the production of compost, the humus like, soil end-product, can be sewage sludge, municipal solid waste (either or not collected in separate organic and inorganic fractions), bark, wood chips, agricultural waste products including manures or any mixture of these materials.[28]

The "black gold" is a stable,[29] rich in nutrients product, with main valuable features like **soil amendment/conditioner** for improvement of soil structure and quality and

20. Besides recycling with 3% and incineration with 0%. European Commission-DG Environment, "Benefits for the former Yugoslav Republic of Macedonia and the other countries of SEE of compliance with the environmental acquis," *Europa – Environment*, http://ec.europa.eu/environment/enlarg/pdf/report_macedonia_feb08.pdf, 57.
21. *Ibid.* 83.
22. COWI A/S, "Preliminary Impact Assessment for an Initiative on the Biological Treatment of Biodegradable Waste," *European Commission Environment*, http://ec.europa.eu/environment/waste/compost/pdf/ia_biowaste_directive_report.pdf, 80.
23. *Ibid.* 70.
24. According to the data on the statistical region Pelagonja (South-Western part of Macedonia), 0,75% of the total quantity of humus is irreversibly lost i.e. the organic carbon in the soil is less than 1% (Ministry of Environment and Physical Planning, *Annual Report on Data for the Quality of the Environment for the Year 2006* (Skopje, RM, 2007), 147.
Macedonia falls into the 45% of European soils that have low organic matter content. European Commission, "Progress Report on the Sustainable Development Strategy 2007," *Sustainable Development-Europa*, *http://ec.europa.eu/sustainable/docs/com_2007_642_en.pdf*. See Figure 2, Annex III.
25. Agricultural techniques widely used in Macedonia are frequent irrigation; repetitive tillage; burning of crop residues after harvest; overgrazing; unbalanced fertilization mainly with N fertilizers due to not taking into account the nutrient value of inorganic fertilizers when planning their applications to the land.
26. Managed rate of decomposition
27. To obtain good quality compost. European Commission, "Report on the National Strategies for reduction of biodegradable waste going to landfill pursuant to Article 5(1) of Directive on the Landfill of Waste (1999/31/EC), (SEC(2005) 404)," *SCADPlus : Landfill of waste*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0105:FIN:EN:PDF, 4.
28. Kor Zwart, "Fate of C and N Pools-Experience from Short and Long Term Compost Experiments" (paper presented at the scientific seminar on Applying Compost-Benefits and Needs, Brussels, Belgium, November 22-23, 2001).
29. Depending on maturity rate i.e. ceased process of degradation

fertilizer supplement for trace elements and N, P, K, containing nutrients. Hence, compost utilization on land (which fulfills heavy metal requirements and sanitation requirements, especially referring to the pathogen reduction) enables agricultural benefit[30] and ecological improvement.[31]

What has been done in Macedonia in terms of composting legislation compared to composting legislation in the EU?

Legislation in the EU relevant to biological treatment of waste

The possible emergence of an independent European Directive on the Biological Treatment of Biowaste ended with the European Commission announcement on abandoning the idea of bringing together the EU Member States regarding "the much needed guidance to help Member States fulfill the targets of the Landfill Directive reducing biodegradable waste landfilling and make waste management investment decisions.[32]" Alternative instruments were offered instead, mainly in the Thematic Strategy on Waste Prevention and Recycling, which proposes quality benchmarks for compost and compost facilities in order to improve market opportunity. However, according to the composting associations the Thematic Strategy on Waste Prevention and Recycling seems too weak and inadequate to tackle such an environmental issue.[33] Furthermore, the Thematic Strategy on Soil Protection[34] and Towards a Thematic Strategy on the Sustainable Use of Natural Resources, are leading the EU "to become a recycling society, that seeks to avoid waste and uses waste as a resource[35]" with a careful examination of "the whole lifecycle of our natural resources.[36]"

On EU level the main legislative requirements on biowaste are channeled through:

- **Waste Framework Directive** (75/442/EEC as amended by 91/156/EEC and currently second reading by Council pending) establishes a framework for the management of waste across the European Community. It also defines certain terms, such as waste, recovery and disposal, to ensure that a uniform approach is taken across the EU. The upcoming revisions of the Waste Framework Directive include change in EU-wide targets for reuse and recycling 50% of household waste by 2020, and for reuse, recycling and recovery of 70% of construction and demolition waste by 2020. There is also a requirement for separate

30. It increases soil organic matter, soil water holding capacity, porosity and drainage, soil workability, minimizes wind and water erosion, lessens the need for inorganic fertilizers, creates beneficial microbial activity in the soil, thus enhancing the health condition of plants as well as avoiding over-fertilized plants.
31. For the purpose of reclamation, restoration and improvement of land
32. Biowaste Coalition Press Release, "Stakeholders disappointed that Commission backs down on strategic biowaste legislation," http://www.eeb.org/press/2005/Biowaste-coalition-press-release-021105.pdf (accessed on September 22, 2008).
33. Fabio Tittarelli and Massimo Centemero, "Compost Production in Italy: State of Art and Perspectives in the Framework of European Union Policy on Biowaste," http://www.compost.it/materiali/COMPOST%20PRODUCTION%20IN%20ITALY.pdf (accessed on September 22, 2008), 2.
34. The proposal for a Framework Directive on soil (COM (2006) 232) was discarded by the Council. EUR-Lex, "Environment policy review (SEC (2008)2150)," *Europa-Environment*. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0409:FIN:EN:HTML.
35. European Commission, "Thematic Strategy on Waste Prevention and Recycling," *Europa-Environment*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0666:FIN:EN:PDF, 6.
36. Europa-Environment, "Commission outlines new Strategy for sustainable use of resources," http://ec.europa.eu/environment/natres/pdf/031001press_release.pdf.

collection of paper, glass, metals and plastic by 2015 where this is technically, environmentally and economically practicable.[37]

- **Landfill Directive** (1999/31/EC) contains far-reaching legislation that impacts both on the management of waste and on specific waste streams. It sets specific requirements for the design, operation and aftercare of landfills, and for the types of waste that can be accepted at landfill sites**.** It requires a definition of test methods for acceptability at landfills. It is mandatory for the waste to be pre-treated before being landfilled and that landfill gas must be collected, treated and used to produce energy.

Standards yield marketability and safe use of compost, but still across the EU Member States (MS), there is at present no uniform system for setting standards. The most important quality standard, the end-of-waste standard, that will "qualify compost as a product on the European market[38]"is in development. Almost all EU-old 15 have compost standards, and many countries have relatively comprehensive systems of standards for compost. The standards can differ quite significantly from one country to the other, and are based on the specific policy frameworks that are established in the MS.[39]

Legislation in Macedonia relevant to biological treatment of waste

Macedonia's environmental institutions are working towards aligning national laws, rules and procedures to the EU *acquis* to contribute to reaching the date for opening accession negotiations. Therefore the legislative set up concerning solid waste management is transposing the main EU Directives' requirements. Each MS in the EU tailors its national legislation on biowaste management. Main policy drivers are the Waste Management Laws; Waste Management Plans; Biowaste Management Strategies; Biowaste/Compost Regulations; Fertilizer Regulations.

Overarching the macedonian legislation on waste management the term composting is mentioned vaguely[40] in the **Law on Waste Management**.[41]This framework law provides general provisions applying to the following issues: definitions and applicability regarding types of waste, strategy, plans and program formulation at different levels; waste management procedures and issuing permits; landfills; incineration and co-incineration of waste, import, export and transit of waste; monitoring, reporting, data management; supervision of competent authorities, punitive provisions. The Ministry of Environment and Physical Planning (MoEPP) is a responsible authority for the implementation and enforcement of this law.

The **Law on Waste Management** has important links to other legislation, relevant to the biowaste management and composting as a process. The **Law on Fertilisers**[42] stipulates terms and conditions for manufacturing, types, application, quality, quality control,

37. Defra, UK-Environmental Protection, "Waste Strategy, Annual Progress Report 2007/08," http://www.defra.gov.uk/ENVIRONMENT/waste/strategy/strategy07/pdf/waste-strategy-report-07-08.pdf, 11

38. European Compost Network-News, Internal Newsletter, www.kompost.at/pages/news/letter/2007/ECN_newsletter_2007_sept_internal.pdf (accessed on September 22, 2008).

39. COWI A/S, "Preliminary Impact Assessment for an Initiative on the Biological Treatment of Biodegradable Waste, " *European Commission Environment*, http://ec.europa.eu/environment/waste/compost/pdf/ia_biowaste_directive_report.pdf, 48-50.

40. In Article 20, paragraph 2, of the Law on Waste Management, Measures and Activities are listed for the Programme on waste management (to be adopted for the realization of the NWMP) enacted by the responsible authority for matters of the environment (Ministry of Environment and Physical Planning). Point 5 states one of the measures and activities is instigating composting of the biodegradable waste. "Law on Waste Management," Official Gazette of RM 68 (2004). However, how it can be achieved, is not mentioned.

41. "Law on Waste Management," Official Gazette of RM 68 (2004).

42. "Law on Fertilizers," Official Gazette of RM, 110 (2007).

labelling, trade and inspection of fertilizers. However, it is acknowledged by the comprehensive composting systems that **Law on Soil Quality** must be drafted, in order for the market on compost to develop and for the user confidence to rise. This law will provide necessary legal basis for quality requirements on compost as soil amendment. Support appears in the form of compost specific regulations, presented by standards on harmful ingredients of the compost,[43] standards on compost use and production phases, as well as hygienic standards (microbiological criteria), compost categories, product analysis processes, Quality Assurance System (QAS). Introduction of tax on landfilling organic waste or ban on landfilling organic waste can further support composting as a recycling process.

Further counting is the **Law on Animal By-products**[44] that regulates the categorization, collecting, transport, disposal, treatment, usage and storage of animal by-products from the aspect of health protection of animals and public veterinary healthcare. Article 4 gives the definition of the plant for composting and Article 14 gives prescriptions on required conditions for operation, technical set up of plants designed for compost and biogas production and ways of performing veterinary inspection and control of animal by-products. The law is co-ordinated by a complementary Rulebook on the special conditions referring to installations, technical units, as well as on the procedures and conditions for conducting proper activity, which must be fulfilled by the oleochemical installations and installations for production of biogas and compost.[45]

The **Law on Organic Agricultural Production**[46] has its own importance as well. It sets in Article 9 regulations for technical requirements on the conditions and practices of organic farming, mandatory period of conversion, threshold parameters on soil improver and amendments, products allowed as fertilizers, products for plant protection against diseases, pests and other requirements. The Rulebook on Organic agricultural and livestock production[47] is the regulatory instrument on fertilizers and soil amendments that regulates the application, restrictions and maximum dose rates on fertilizers and soil improvers permitted for use in **organic farming**.

The **Law on Agricultural Land**[48] prescribes measures for increasing soil fertility and measures mainly for protecting land against erosion and enquires that agricultural land is well managed through legal security of owners. The **Law on Environment**[49] includes basic issues such as environmental permits, Environmental Impact Assessment procedure, and greenhouse gas emissions. Plant design and licensing regulations like Integrated Pollution Prevention and Control (IPPC) permits are important for regulating sitting, emissions, plant management and occupational health issues. The **Law on Water Management**[50] determines general standards and principles for the manner of water management. It directly transposes six EU Directives of which relevant to the composting treatment are the Sludge directive and the Nitrate directive.

The **National Waste Management Strategy 2008-2020 (NWMS)** foresees "planning of the reductions of disposal of biodegradable waste" in the policy and planning

43. Especially for limit values on heavy metals (especially for Cd and Hg) and for organic compounds and impurities thresholds
44. "Law on Animal By-products, " Official Gazette of RM, 113 (2007).
45. "Rulebook on the special conditions referring to installations, technical units, as well as on the procedures and conditions for conducting proper activity, which must be fulfilled by the oleochemical installations and installations for production of biogas and compost", Official Gazette of RM, 00 (2007).
46. "Law on Organic Agricultural Production, " Official Gazette of RM, 16 (2004).
47. "Rulebook on Organic agricultural and livestock production, " Official Gazette of RM, 60 (2006).
48. "Law on Agricultural Land, " Official Gazette of RM, 135 (2007).
49. "Law on Environment, " Official Gazette of RM, 53 (2005).
50. "Law on Water Management, " Official Gazette of RM, 68 (2004).

documents (part of the priority measures and actions), local authorities to be heavily involved in the management of biodegradable waste, and waste management in general.

The **Law on Local Self-Government**[51], transferred communities' responsibilities towards the local authorities (the 84 municipalities and the City of Skopje), on most of the proposed tasks regarding waste management.[52]

Implementation process: from pilot projects to sustainability

Macedonia is about to set milestones on biodegradable waste going to landfills, with capture-rates of 75% by 2015 and 50% by 2020. Nowadays the perception of the system is as an additional financial burden on the total waste management costs.[53] Nevertheless, as enclosed in the NWMS, those investments shall become unavoidable at the end of the implementation time of the waste management strategy.[54]

Design and construction/operation of installations for reduction of **biodegradable waste** fractions in landfills, with stakeholders the Ministry of Agriculture, Forestry and Water Economy (MoAFWE), the MoEPP, animal breeding farms, food production industry, and slaughterhouses prescribed in the National Waste Management Plan 2006-2012 (NWMP),[55] need to be implemented in the time frame of 2008 till 2012. "Economical spurs aimed at the population and the economy on minimizing waste and maximizing prudent re-use of wastes, should be embodied in the policy framework on waste management[56]" Unfortunately so far this has remained only on paper.

The municipalities with their scarce resources plan, invest and also encourage the private sector to invest in small-scale treatment capacity for biodegradable waste. Nowadays, pilot projects are envisaged only in some municipalities in Macedonia like the municipalities of Ilinden, Veles, Gazi Baba, Kocani.[57] They are the forerunners of composting in Macedonia, but because of unresolved obstacles they still remain only as pilot projects.

The lack of enforcement of existing relevant legislation as well as lack of national standards on composting, lack of organized separate collection of municipal solid waste and agriculture waste, underpinned by low public awareness, lack of identified potential compost users and markets, lack of proper organizational and managerial structure on project activities are identified as the main reasons for abandoning the pilot projects for central composting plant at municipality level. This was the case with the municipality of Zrnovci and the municipality of Resen. The constraints of not having, for the time being, composting industry set up on national level i.e. on regional central composting schemes, can be located in the underperformance of the collection practices in Macedonia[58] and the not existent separate collection of municipal

51. "Law on Local Self-Government, " Official Gazette of RM, 5 (2002).
52. Organizing collection, transportation and disposal of municipal wastes; supervising transportation and disposal of industrial non-hazardous waste; deciding on the location of waste management facilities; issuing local regulations on waste management; financing and supervising dump/landfill closures and termination of waste management facilities; participating in regional projects.
53. Ministry of Environment and Physical Planning, *National Waste Management Plan 2006-2012* (Skopje, RM, September, 2005), 38.
54. Ministry of Environment and Physical Planning, *National Waste Management Strategy 2008-2020* (Skopje, RM, March 2008), 86/106.
55. *Ibid.* 90/106.
56. Ministry of Health, *National Health-Ecological Action Plan of the Republic of Macedonia* (Skopje, RM, March, 1999), 42-43.
57. See the official web site of the Ministry of Local Self-Government: http://www.mls.gov.mk/default.aspx?id=29&sm=29.
58. In line with this"…In the larger cities and towns, the waste management system is more organised. The collection services are provided at least once a week, however mostly using outdated and low capacity collection vehicles. In rural areas the limited collection services, if any, are usually performed by a tractor and trailer, sometimes by a small multi-purpose municipal vehicle." Ministry of Environment and Physical Planning, *National Waste Management Plan 2006-2012* (Skopje, RM, September, 2005), 18.

solid waste, which will ensure clean and continuing waste input to the composting process and lead to a high quality compost.[59]

Furthermore, analyses from pilot projects show that from the four main categories of composting technologies - windrow, aerated static pile, in-vessel composting and anaerobic processing[60] - **the best applicable treatment for the municipalities is the aerated static pile**. The collected wastes are piled together onto an aerated floor. With mixing and blending of the pile waste, aerobic conditions are maintained for the process of composting. It is essential to have proper carbon/nitrogen (C/N) ratio and to establish and monitor the composting process itself for optimal moisture and oxygen content, bulk density, temperature, active composting. The installation can be covered or semi-covered, to avoid water run-off in the pile and to maintain the optimal moisture content. By this technology active composting can take from 2 to 6 weeks. The beneficial use of compost attained by this technique is mainly sought in the agriculture sector of Macedonia, as soil conditioner i.e. organic fertilizer or it can be marketed outside Macedonia in the agriculture and horticulture sector (for example as soil amendment to peat).

At large livestock farms, with high water content of the biowaste i.e. slurries, composting is not always feasible solution to biowaste management. Therefore, "in-house anaerobic digestion is an economic solution for companies, because of the minimal space requirements and the volume reduction it offers, while at the same time generating energy for the operation.[61]" It requires highly efficient digester (reactor), for producing biogas (mixture of methane and carbon dioxide) trough fermentation of the biowaste. The biogas, methane, is generally burnt on site for heating or for producing electricity on a small scale.

This process is prescribed in Article 7 of the Law on Waste Management where the waste treatment hierarchy stipulates that waste should be utilized as an energy resource. Example for such a venture is the **Methane Recovery Project "Agria Group"** in Gradsko,[62]a farm with 30.000 pigs, with aims to utilize biogas from anaerobic digestion of swine manure, as a replacement of oil and electricity, mainly for heating of one of the barns (the total number is 40 barns) where intensive swine growth occurs. The gains are seen three-fold: reduction of GHG emissions; use of biowaste as a source for generating energy; anaerobic digestion being an environmentally friendly technology that prevents raw manure to be discharged in nearby water bodies.

Ultimately, the choice of composting method will depend to a large extent on: the scale of farming operation; equipment and financial resources on hand (since this is a costly process); awareness by the managerial set up in a company on sustainable technologies on waste management and willingness to accept and pursue them.

59. Mature and released from impurities as market demand

60. For definitions see AnnexII.

61. Klaus Fischer, "Biological waste management and treatment in Europe" (paper presented at the International Conference on Environmental Research and Technology, Penang, Malaysia, May 28-30, 2008).

62. Italian Ministry for the Environment, Land and Sea, "Assessment of the Projects' Potential in the fields of Renewable Energy Resources, Energy Efficiency and Forestry Management in the framework of Clean Development Mechanism of the Kyoto Protocol in the Republic of Macedonia", http://www2.minambiente.it/pdf_www2/CDM_Portfolio_Balcani_2007/CDM_Portfolio_Macedonia/CDM_Portfolio_Macedonia_280407_EN.pdf (accessed on October 5, 2008).

Tangible benchmarks in composting

The on-going implementation of the biowaste treatment roadmap, through the pilot projects and the enacted legal framework of the Law on Waste Management, should be enhanced, for it can lead towards protection of the nature from environmental degradation and to secure, cleaner and healthier living place. Recommendations on measurements towards comprehensive approach of composting as a biowaste management option are:

-Implementation of the Law on Waste Management having the State Environmental Inspectorate within the MoEPP, as the section with a pivotal role. It needs institutional strengthening, especially in terms of human resources, staff training so that the inspectors can achieve wider coverage by integrated, targeted inspections;

- Campaigns managed by the MoEPP and relevant stakeholders on public awareness on implementation of the Law on Waste Management. Good example is the government's ongoing information campaign on the newly adopted Law on Public Cleanness (prescribing misdemeanours for individuals and legal entities) of in the daily newspapers, which should be backed up by television and radio commercials, so that it can cover the whole country. The economic instruments should be ushered for change in behaviour too, not solely for "raising revenue". Greater visibility and transparency of the legal and normative basis is a must, for a society that integrates the sustainability principles at all levels;

- Workshop activities on municipal level for creating local biowaste planning programs with targets for reduction. Cooperation between the local and national authorities and sufficient incentives are crucial for viable and responsive to the real needs of composting;

- Simplification of the existing regulatory framework, whilst input, process and product related regulations and application related framework need to be developed in order to avoid bottleneck situations in trade and application of compost, as well as for environmental and precaution reasons;

- Having MAFWE as key stakeholder in organic agriculture, immediate promotion and subvention of organic production, providing education to the potential customers (mainly the farmers) on compost use, is needed. The compost market should be fore-grounded in the agriculture sector of Macedonia, before opening to external markets. It is simple - the opportunity should be turned to demand. Creation and realization of specific marketing plan for the compost is the road for achievement of the preceding.

Minimizing biowaste volumes into a sustainable way, soil improvement and climate change abatement through reduced emissions of GHG-methane (landfill gas) is what Macedonia needs. With only one process-composting ecologically and agriculturally useful application of biowaste can be achieved. Hence, the implementation of this technology following the above stated recommendations is welcomed as soon as possible.

Annex I

List of biowastes suitable for biological treatment and/or spreading on the soil:

The 6-digit code refers to the correspondent entry in the European List of Waste (2000/532/EC).

Waste code	Waste description	Additional comments and use restrictions
02 00 00	Waste from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing	
02 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing	
02 01 01	Sludges from washing and cleaning	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture and without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 01 02	Animal-tissue waste	Only for animal tissues deemed to be fit for human consumption and as a left-over of food preparations. Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 01 03	Plant-tissue waste	
02 01 06	Animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site	Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 01 07	Wastes from forestry	Bark left in a natural state and wood waste left in a natural state may be spread on land untreated.
02 02	Waste from the preparation and processing of meat, fish and other foods of animal origin	
02 02 01	Sludges from washing and cleaning	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture and without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 02 02	Animal-tissue waste	Only for animal tissues deemed to be fit for human consumption and as a left-over of food preparations. Without prejudice to Directive 90/670/EEC on animal

Waste code	Waste description	Additional comments and use restrictions
		waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 02 03	Materials unsuitable for consumption or processing	Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 02 04	Sludges from on-site effluent treatment	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture and without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 02 99	Waste not otherwise specified	Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 03	Wastes from the fruit, vegetables, cereals, edible oils, cocoa, coffee, tea and tobacco preparation and processing; conserve production; yeast and yeast extract production, molasses preparation and fermentation	
02 03 01	Sludges from washing, cleaning, peeling, centrifuging and separation	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
02 03 04	Materials unsuitable for consumption or processing	
02 03 05	Sludges from on-site effluent treatment	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
02 03 99	Waste not otherwise specified	
02 04	Wastes from sugar processing	
02 04 02	Off-specification calcium carbonate	
02 04 03	Sludges from on-site effluent treatment	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
02 05	Wastes from the dairy products industry	
02 05 01	Materials unsuitable for consumption or processing	Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 05 02	Sludges from on-site effluent treatment	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture and without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
02 05 99	Waste not otherwise specified	Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]

Waste code	Waste description	Additional comments and use restrictions
02 06	Wastes from the baking and confectionery industry	
02 06 01	Materials unsuitable for consumption or processing	
02 06 03	Sludges from on-site effluent treatment	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
02 07	Wastes from the production of alcoholic and non-alcohol beverages (except coffee, tea and cocoa)	
02 07 01	Wastes from washing, cleaning and mechanical reduction of raw materials	
02 07 02	Wastes from spirits distillation	
02 07 04	Materials unsuitable for consumption or processing	
02 07 05	Sludges from on-site effluent treatment	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
02 07 99	Waste not otherwise specified	
03 00 00	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard	
03 01	Wastes from wood processing and the production of panels and furniture	
03 01 01	Waste bark and cork	Bark and cork left in a natural state (except from trees and bushes from roadside) may be spread on land untreated. Bark and cork from trees and bushes from roadside may only be spread on land if they comply with at least Class 3 compost requirements.
03 01 05	Sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04	Sawdust and sawmill waste of untreated wood kept in its natural state from the area of wood processing may be spread on land untreated.
03 03	Wastes from pulp, paper and cardboard production and processing	
03 03 01	Waste bark and wood	Bark left in a natural state (except from trees and bushes from roadside) may be spread on land untreated. Bark trees and bushes from roadside may only be spread on land if it complies with at least Class 3 compost requirements.
03 03 02	Green liquor sludge (from recovery of cooking liquor)	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
03 03 05	De-inking sludges from paper recycling	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
03 03 07	Mechanically separated rejects from pulpig of waste paper and carboard	
03 03 08	Wastes from sorting of paper and cardboard destined for recycling	
03 03 09	Lime mud waste	
03 03 10	Fibre rejects, fibre-, filler- and coating sludges from mechanical separation	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
03 03 11	Sludges from on-site effluent treatment other than those mentioned in 03 03 10	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
04 00 00	Waste from the leather, fur and textile industries	
04 01	Wastes from the leather and fur industry	
04 01 06	Sludges, in particular from on-site effluent treatment containing chromium	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture
04 01 07	Sludge, in particular from on-site effluent treatment free of chromium	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.

Waste code	Waste description	Additional comments and use restrictions
04 02	Wastes from the textile industry	
04 02 20	Sludges from on-site effluent treatment other than those mentioned in 04 02 19	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
04 02 21	Wastes from unprocessed textile fibres	Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000].
04 02 22	Wastes from unprocessed textile fibres	Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000].
15 00 00	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified	
15 01	Packaging (including separately collected municipal packaging waste)	
15 01 01	Paper and cardboard packaging	
15 01 03	Wooden packaging	
19 00 00	Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use	
19 06	Wastes from anaerobic treatment of waste	
19 06 04	Digestate from anaerobic treatment of municipal waste	
19 06 06	Digestate from anaerobic treatment of municipal waste	Without prejudice to Directive 90/670/EEC on animal waste [see Proposal for a Regulation laying down the health rules concerning animal by-products not intended for human consumption, COM(2000) 574 final of 19.10.2000]
19 08	Wastes from waste water treatment plants not otherwise specified	
19 08 05	Sludges from treatment of urban waste water	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
19 08 12	Sludges from biological treatment of industrial waste water other than those mentioned in 19 08 11	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
19 08 14	Sludges from other treatment of industrial waste water other than those mentioned in 19 08 13	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
19 09	Wastes from the preparation of water intended for human consumption or water for industrial use	
19 09 01	Solid waste from primary filtration and screenings	
19 09 02	Sludges from water clarification	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.
19 09 03	Sludges from decarbonation	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.

Waste code	Waste description	Additional comments and use restrictions
20 00 00	Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions	
20 01	Separately collected fractions (except 15 01)	
20 01 01	Paper and cardboard	The addition of high-gloss paper and waste wallpaper is not permitted.
20 01 08	Biodegradable kitchen and canteen waste	
20 01 25	Edible oil and fat	Only for anaerobic digestion.
20 01 38	Wood other than that mentioned in 20 01 37	
20 02	Garden and park wastes (including cemetery waste)	
20 02 01	Biodegradable waste	Except grass and bush cuttings from roadside.
20 03	Other municipal wastes	
20 03 01	Mixed municipal waste	Only for mechanical/ biological treatment.
20 03 02	Waste from markets	Only if the biowaste is separately collected, otherwise only for mechanical/ biological treatment.
20 03 04	Septic tank sludge	Only if it fulfils the requirements of Directive 86/278/EEC for the use of sludge in agriculture.

Source: European Commission, "Working Document, Biological Treatment of Biowaste, 2nd draft," http://www.emcc.cn/chinese/classweb/Working%20Document%20on%20Biological%20Treatment%20of%20Biowaste%202nd%20DRAFT.pdf (accessed on September 10, 2008).

Annex II

List of definitions:

- 'green and wood waste' means vegetable waste from gardens and parks, tree cuttings, branches, grass, leaves (with the exception of street sweepings), sawdust, wood chips and other wood waste not treated with heavy metals or organic compounds;
- 'municipal waste' means waste from households, as well as other waste which, because of its nature or composition, is similar to waste from households;
- 'biogas' means the mixture of carbon dioxide, methane and trace gases resulting from the controlled anaerobic digestion of biowaste;
- 'windrow composting' means the composting of biowaste placed in elongated heaps which are periodically turned by mechanical means in order to increase the porosity of the heap and increase the homogeneity of the waste;
- 'in-vessel composting' means the composting of biowaste in a closed reactor where the composting process is accelerated by an optimised air exchange, water content and temperature control;
- 'community composting' means the composting of biowaste by a group of people in a locality with the aim at composting their own and other people's biowaste in order to manage the supplied biowaste as close as possible to the point at which it was produced;
- 'mechanical/biological treatment' means the treatment of residual municipal waste, unsorted waste or any other biowaste unfit for composting or anaerobic digestion in order to stabilise and reduce the volume of the waste;
- 'treatment' means composting, anaerobic digestion, mechanical/ biological treatment or any other process for sanitising biowaste;
- 'plant' means any technical unit and equipment dedicated to the treatment of biowaste via composting, anaerobic digestion or mechanical/biological stabilisation as well as any equipment dedicated to the treatment of air emissions and wastewater;
- 'separate collection' means the collection of biowaste separately from other kinds of waste in such a way as to avoid the different waste fractions or waste components from being mixed, combined or contaminated with other potentially polluting wastes, products or materials;
- 'impurities' means the presence of fragments of plastic, glass, metals or similar nonbiodegradable materials, with the exclusion of sand, gravel and small stones;

Source: European Commission, "Working Document, Biological Treatment of Biowaste, 2nd draft," http://www.emcc.cn/chinese/classweb/Working%20Document%20on%20Biological%20Treatment%20of%20Biowaste%202nd%20DRAFT.pdf (accessed on September 10, 2008).

Annex III

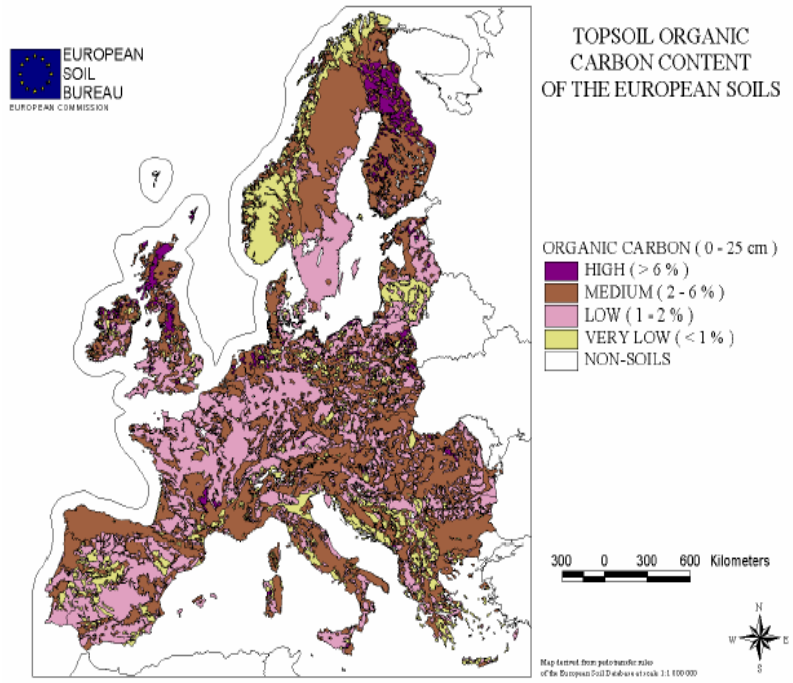

Figure 2. Topsoil organic carbon content of the European soils.

Source: European Commission, "Progress Report on the Sustainable Development Strategy 2007," *Sustainable Development-Europa,* http://ec.europa.eu/sustainable/docs/com_2007_642_en.pdf.

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